

Infrared Astronomy in Antarctica

Takashi Ichikawa[1]; Naruhisa Takato[2]; Makoto Taguchi[3]; Shoichi Okano[4]; Takeshi Sakanoi[5]

[1] Astronomical Institute, Tohoku Univ.; [2] Subaru Telescope, NAOJ; [3] NIPR; [4] PPARC, Tohoku Univ.; [5] PPARC, Grad. School of Sci., Tohoku Univ.

<http://www.astr.tohoku.ac.jp/~ichikawa>

To clarify the technical issues to construct a future mid-size astronomical infrared telescope for the studies of the atmosphere of solar planets and satellites, search for extra solar planet, deep survey of distant galaxies, etc., we have developed a small infrared telescope, which are dedicated for measurement of atmospheric transmission and turbulence of Antarctic atmosphere. In this paper, we report the current progress and the prospect of infrared astronomy at Antarctica.

Antarctica is said to be the last window open to space for astronomy, especially in infrared and tera-hertz radio astronomy, because of very dry atmosphere and low temperature. The domes higher than 3000m above sea level located at inner Antarctica are expected to be the best location for astronomy. The high atmospheric pressure gives comparatively stable atmosphere. Moreover, due to the temperature as low as -70 Celsius in winter, a 2m telescope is as powerful in near-infrared as an 8m telescope like Subaru Telescope located at 4200 m altitude. Polar nights allow us to observe object continuously for many nights, which is very advantageous for observations of extra solar planets with long revolution period and long-term variable stars. Therefore, telescopes constructed in inner Antarctica will open new era for astronomy in near-infrared and tera-hertz astronomy.

In 1990's, a 60cm near-infrared telescope was built at South Pole. However, due to bad weather and strong wind, which degrades stellar images, the observation finished. South Polar is located at slanting surface, where katabatic wind is very strong. On the other hand, domes in inland Antarctica are in high pressure area, so that atmosphere is very stable. Since they are located at high altitude, we expect small water vapor and very transparent atmosphere. In fact, groups of Australia and Europe have constructed an astronomical station at Dome C (3250 m) and started the site evaluation. An Italian group has started astronomical observations with 80 cm infrared telescope. Astronomers from China and USA are collaborating for the site test at Dome A (4093m) since 2006.

National Polar Institute Japan has facilities at Dome Fuji, which is located at very high altitude (3810 m). There are 70% clear days. Since the location is expected to be one of the best locations for infrared astronomy, we consigned the observations with SODAR to 48th Antarctic survey party. Then we obtained the data of astronomical atmospheric turbulence at Dome Fuji for the first time. We are discussing about further site evaluation at Dome Fuji, technical issues for astronomical instruments, and problems for the construction of telescopes at such harsh environment as Antarctica. In the course, we have developed a small (40cm) near-infrared telescope dedicated for the operation at -80 Celsius. The telescope will be moved, in middle Feb. 2008, to Rikubetsu-cho in Hokkaido, the most coldest place in Japan, for the test operation. In next winter, we will operate the telescope equipped with 3-color near-infrared camera, which is now under construction, in 2009 and 2010 winters at University of Alaska, Fairbanks under more harsh environment. We also plan to operate it via internet from Japan, simulating the operation at Dome Fuji from Japan.

A 40 m tower equipped with supersonic-sound anemometers will be most useful for the measurement of micro-turbulence at surface boundary layer. We plan to install the 40cm telescope along with the tower at Dome Fuji in near future. The telescope will give us not only environmental data for astronomy but also scientific astronomy data, which will demonstrate the advantage of astronomical observations in Antarctica. These test observations will give us clues to solving the technical difficulties to construct large telescope, e.g., 2.5m infrared telescope, and facilities for astronomical observatory.